Genetic algorithms as a means to uncovering novel holographic photonic crystal structures

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Holographic lithography is an attractive technique for the fabrication of large-area, defect-free, three dimensional photonic crystals. Periodic structures were formed in the photoresist SU8, through concurrent exposure with 4 non-coplanar coherent beams of laser radiation (λ=351 nm). This generated a 3-D latent image within the photoresist which was developed using standard techniques, resulting in a 3-D microperiodic structure. Given the intensity, polarization, direction, and phase of each incident beam, it is straightforward to calculate the resultant intensity pattern. However, the inverse relationships between a given structure and the beam parameters are non-trivial and have not been fully established. We propose and will employ the use of genetic algorithms to solve for the beam parameters given an arbitrary structure. This approach may be interfaced with an iterative evaluation of the photonic bandgap properties in order to uncover interesting new structures which could be fabricated by multi-beam holography. Our genetic algorithm approach is a promising, versatile step towards the determination of the beam parameters required to fabricate novel holographic structures with potentially superior photonic bandgap properties.